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ABSTRACT

Over the last few years, the research into agriculture has gained momentum, showing signs of rapid growth. The latest to appear on the scene is bringing convenience in how agriculture can be done by employing various computational technologies. To implement this project we have used LAND satellite images which contains images of FOREST, AGRICULTURE LAND, URBAN AREA and Range LAND. However, only a few studies have compared the performances of these classifiers with different training sample sizes for the same remote sensing images, particularly the Sentinel-2 Multispectral Imager (MSI). In this study, we examined and compared the performances of the RF, kNN, and SVM classifiers for land use/cover classification using Sentinel-2 image data. An area of 30 × 30 km2 within the Red River Delta of Vietnam with six land use/cover types was classified using 14 different training sample sizes, including balanced and imbalanced, from 50 to over 1250 pixels/class. All classification results showed a high overall accuracy (OA) ranging from 90% to 95%. Among the three classifiers and 14 sub-datasets, SVM produced the highest OA with the least sensitivity to the training sample sizes, followed consecutively by RNN and kNN. In relation to the sample size, all three classifiers showed a similar and high OA when the training sample size was large enough, i.e., greater than 750 pixels/class or representing an area of approximately 0.25% of the total study area. The high accuracy was achieved with both imbalanced and balanced datasets.

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1. INTRODUCTION

we studied the potential of high spatial and temporal resolution Sentinel-1 remote sensing data for different agriculture land cover mapping applications and assessed the new deep learning techniques. We proposed to use two deep RNN approaches to explicitly consider the temporal Correlation of Sentinel-1 data, which were applied on the Camargue region.

We demonstrated that even with the classical approaches (*KNN*, *RF* and *SVM*), good classification performance could be achieved with Sentinel-1 SAR image time series. We experimentally demonstrated that the use of recurrent neural networks to deal with SAR Sentinel-1 time series data yields a consistent improvement in agricultural classes as compared with classical machine learning approaches. The experiments highlight the appropriateness of a specific class of deep learning models (RNNs) which explicitly consider the temporal correlation of the data in order to discriminate among agricultural classes of land cover, typically characterized by similar but complex temporal behaviors.

1.1 MOTIVATION

Both the theory and practice tell us that although land cover (LC) and land use (LU) are closely related, thus many proposed land use classifications are actually mixing land cover and land use where natural and semi-natural vegetation are described in terms of land cover, agricultural and urban areas in terms of land use, and, in particular, the definition of forests is a combination on land cover and land use. Still it is necessary to develop LU classification separately from LC classification due to the differences between these two and the importance of LU statistics for related policy analysis and decision making.

1.2 PROBLEM DEFINITION

We demonstrated that even with the classical approaches (*KNN*, *RF* and *SVM*), good classification performance could be achieved with Sentinel-1 SAR image time series.

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SAR Sentinel-1 time series data yields a consistent improvement in agricultural classes as compared with classical machine learning approaches. The experiments highlight the appropriateness of a specific class of deep learning models (RNNs) which explicitly consider the temporal correlation of the data in order to discriminate among agricultural classes of land cover, typically characterized by similar but complex temporal behaviors.

1.3 OBJECTIVE OF PROJECT

In this paper, we studied the potential of high spatial and temporal resolution Sentinel-1 remote sensing data for different agriculture land cover mapping applications and assessed the new deep learning techniques. We proposed to use two deep RNN approaches to explicitly consider the temporal Correlation of Sentinel-1 data, which were applied on the Camargue region.

2.AIM AND SCOPE OF THE PRESENT INVESTIGATION

2.1 Scope:

The proposed LU classification reflects the close relationship and integrative nature of the work on LU databases/datasets by various Departments and Divisions at FAO as discussed in the previous section. It is a consolidated summary of the LU classifications used in WCA2010 and the questionnaires for the dataset “Land” under “Resources”, which are the higher level and more aggregated classes for agricultural land use; the LU classifications used in AGROMAPS and the questionnaires for the dataset “Area Harvested” under “Production,” which in fact are the crop classification as in ICC (discussion on the similarity and difference between the product classification and the crop classification can be found in the document of WCA2010); and the LU classification used in FRA2010, which is those classes for forest land use.

2.2 LIMITATIONS OF PROJECT

only a few studies have compared the performances of these classifiers with different training sample sizes for the same remote sensing images, particularly the Sentinel-2 Multispectral Imager (MSI).

2. 3 LITERATURE SURVEY

2.3.1 Rice crop mapping and monitoring using ERS-1 data based on experiment and modeling results

Authors: T. Le Toan,F. Ribbes,Li-Fang Wang

Abstract: Information on rice growing areas and on rice growth conditions are necessary in rice monitoring programs and in studies on the emission of methane from flooded rice fields. The objective of this paper is to assess the use of ERS-1 SAR data to map rice growing areas and to retrieve rice parameters. The approach

includes first a synthesis of experimental results at two different test areas followed by a development of a theoretical model to interpret the observations. The synthesis of experimental data at two test areas, a tropical site with short cycle rice (Semarang, Indonesia) and a temperate site with long cycle rice (Akita, Japan), has shown that flooded rice fields have characteristic increasing temporal radar responses. When the radar backscattering coefficients are expressed as a function of the rice biomass, the effect of cultural practices and climate (long cycle versus short cycle) is reduced. The observations have been interpreted by a theoretical model, which relies on a realistic description of rice plants and which considers the backscattering enhancement and clustering effects of the scatterers. Good agreement has been obtained between experimental data and theoretical results. The strong temporal variation of the radar response of rice fields is due to the wave-vegetation-water interaction, which increases from the transplanting stage to reproductive stage. By simulations using the validated model, the length of the rice cycle or the rice varieties have shown minor effects on the temporal curve. A method for rice fields mapping has been developed, based on the temporal variation of the radar response between two acquisition dates. Inversion of SAR images into plant height and plant biomass has also been performed. The results appear promising for the use of ERS-1 and RADARSAT data for rice monitoring.

2.3.2 Sentinel-2: ESA's Optical High-Resolution Mission for GMES Operational Services

Authors: Drusch, M.; Bello, U.D.; Carlier, S.; Colin, O.; Fernandez, V.; Gascon, F.; Hoersch, B.; Isola, C.; Laberinti, P.; Martimort, P.; et al.

Abstract: Global Monitoring for Environment and Security (GMES) is a joint initiative of the European Commission (EC) and the European Space Agency (ESA), designed to establish a European capacity for the provision and use of operational monitoring information for environment and security applications. ESA's role in GMES is to provide the definition and the development of the space- and ground-related system elements. GMES Sentinel-2 mission provides continuity to

services relying on multi-spectral high-resolution optical observations over global terrestrial surfaces. The key mission objectives for Sentinel-2 are: (1) To provide systematic global acquisitions of high-resolution multi-spectral imagery with a high revisit frequency, (2) to provide enhanced continuity of multi-spectral imagery provided by the SPOT (Satellite Pour l'Observation de la Terre) series of satellites, and (3) to provide observations for the next generation of operational products such as land-cover maps, land change detection maps, and geophysical variables. Consequently, Sentinel-2 will directly contribute to the Land Monitoring, Emergency Response, and Security services. The corresponding user requirements have driven the design toward a dependable multi-spectral Earth-observation system featuring the Multi Spectral Instrument (MSI) with 13 spectral bands spanning from the visible and the near infrared to the short wave infrared. The spatial resolution varies from 10 m to 60 m depending on the spectral band with a 290 km field of view. This unique combination of high spatial resolution, wide field of view and spectral coverage will represent a major step forward compared to current multi-spectral missions. The mission foresees a series of satellites, each having a 7.25-year lifetime over a 15-year period starting with the launch of Sentinel-2A foreseen in 2013. During full operations two identical satellites will be maintained in the same orbit with a phase delay of 180° providing a revisit time of five days at the equator. This paper provides an overview of the GMES Sentinel-2 mission including a technical system concept overview, image quality, Level 1 data processing and operational applications.

2.3.3 A survey of image classification methods and techniques for improving classification performance

Authors: **Lu, D.; Weng, Q. A**

Abstract: Image classification is a complex process that may be affected by many factors. This paper examines current practices, problems, and prospects of image classification. The emphasis is placed on the summarization of major advanced classification approaches and the techniques used for improving classification accuracy. In addition, some important issues affecting classification performance are discussed. This literature review suggests that designing a suitable image-processing procedure is a prerequisite for a successful classification of remotely sensed data

into a thematic map. Effective use of multiple features of remotely sensed data and the selection of a suitable classification method are especially significant for improving classification accuracy. Non-parametric classifiers such as neural network, decision tree classifier, and knowledge-based classification have increasingly become important approaches for multisource data classification. Integration of remote sensing, geographical information systems (GIS), and expert system emerges as a new research frontier. More research, however, is needed to identify and reduce uncertainties in the image-processing chain to improve classification accuracy.

2.3.4 On farm assessment of rice yield variability and productivity gaps between organic and conventional cropping systems under Mediterranean climate

Authors: Delmotte, S.; Tittonell, P.; Mouret, J.C.; Hammond, R.; Lopez-Ridaura, S

Abstract: Organic rice production is characterized by high yield variability and substantial productivity gaps with respect to conventional systems. Variability may be accentuated in areas of erratic climate, such as in the Mediterranean region of *La Camargue* in southern France. While management recommendations for organic cropping systems are not readily available, innovative farmers develop strategies to achieve high, and less variable, yields. The objectives of this study were to identify the main factors affecting yield variability and the farmer management strategies used to sustain crop productivity while reducing input use. Participatory monitoring of farmer fields for yields, yield components, soil condition, weeds and management practices from 1992 to 2009 resulted in a database of more than 380 entries. These data included continuous, discrete and nominal variables. They were explored using classification and regression trees to describe management strategies under conventional and organic systems and to identify and categorise the main variables associated with rice yield variability. Rice yields varied between 0.5 and 10 t ha^{-1} under conventional and between 0 and 9 t ha^{-1} under organic management. Weed competition was the main factor affecting yield for both conventional and organic systems. The gap between